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# MFiS

**Marine Fisheries Information Service** Technical & Extension Series

भाकृअनुप
ICAR

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CMFRI

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Anchovy landings at Azheekal Fisheries Harbour

(Photo Credit: Paulose Jacob Peter )

Marine Fisheries Information Service Technical and Extension Series envisages dissemination of information on marine fishery resources based on research results to the planners, industry and fish farmers, and transfer of technology from laboratory to the field.

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## From the Editorial Board

Warm greetings to all our esteemed readers

The Food and Agriculture Organization (FAO) estimated the total marine wild fish catch in the world at 79.3 million t in 2016, of which, nearly 35% entered the international trade either for food or non-food (fish oil, fish meal etc) uses. All fishery resources are dynamic and have an underlying spatial component, reflected in their distribution and abundance patterns in the marine ecosystem. The spatial analysis approach enables fish biomass to be disaggregated by region or life-history stages and incorporating this information in fish stock assessment models allows better management actions to regulate fishing mortality and design appropriate conservation activities. In India, area specific fishery management plans are mooted under the newly proposed National Marine Fisheries Policy (NMFP, 2017). ICAR-CMFRI which has been estimating the maritime state based fish catch and effort trends since 1950 has moved to a data collection and reporting system using electronic tablets which enabled spatial data reporting with passive geo-referencing since 2018. How effectively this spatial information can be tapped to surpass the existing fish stock assessment models will have to be evaluated with case studies in the Indian marine fisheries sector. Regarding boosting of marine fish production through mariculture, the emphasis is on good husbandry practices during the broodstock development and the larval rearing phase with protocols developed for each species of interest. Hence, research communications on various aspects of marine capture fisheries and mariculture are presented in this issue of MFIS.

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# Contents

# Life cycle of anchovy and climate driven changes in its distribution on the southwest coast of India

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## Abstract

Large scale fluctuations of anchovy catch are observed across Indian coast and an understanding of the complex interactions of climato-oceanic and biological factors of fishes is essential to realize the cause of such catch variations. Therefore, the trend of sea surface temperature anomaly in the context of the spatial and temporal aspects of anchovy (*Stolephorus* spp.) fisheries along southwest coast of India were investigated. The coast was classified into three strata; first (ST_1, 8° to 10.2° N), second (ST_2, 10.2° to 13° N) and third (ST_3, 13° to 16° N) to study the spatial variation. Similarly, seasonality was studied by considering three seasons in a year as pre-monsoon (February-May, PRM), monsoon (June-September, MON) and post-monsoon (October-January, POM). The catch (kg) per unit effort (hour) for the all gears operated was also analyzed to observe the distribution of *Stolephorus* spp. The impact of climate change on *Stolephorus* fisheries was evident in both vertical and horizontal shifting of the catch.

***Key words**: Stolephorus* spp., sea surface temperature, catch shifts

## Introduction

Anchovy fisheries are constituted by five genera belonging to Engraulidae family, but maximum catch is accounted by the genus *Stolephorus* in Indian marine fishery. Commonly known as whitebait, about seven species occur in fishery along southwest coast of India and is hereafter referred to as *Stolephorus*. During 80's decades, about 70% of total landed *Stolephorus* along the southwest coast of India was accounted from the coast extending from Cape Comorin to Quilon at the depth between 10 and 50 m (Luther, 1979). These fishes are plankton feeders, mainly zooplankton with copepods, cladocerans, lucifer and fish larvae dominating. Changes in physico-chemical properties of the ecosystem regulate its migration, resulting on the annual and seasonal fluctuations in its fisheries. The northward distribution of the stock in shallow shelf water from October onwards and the southward distribution from March-April onwards are evidently governed by the current patterns during the southwest monsoon and post-monsoon period. This study reports the distributional shift of *Stolephorus* along southwest coast of India against the recent scenario of rising Sea Surface Temperature (SST) under the influence of climate change phenomenon.

## Sea Surface Temperature

SST was retrieved at 1° spatial resolution for the period from 1988 to 2016 on monthly basis from NOAA Optimum Interpolation (OI) SST, V2 in Asia Pacific Data Research Centre website (http://apdrc.soest.hawaii.edu) for southwest coast of India between 8° to 16° N latitude and 73° to 77° E longitude. NOAA-bathymetric maps in R (library Marmap) were used to partition data for depth up to 100 m. The partitioned data was used in analysis of the SST anomaly. The statistical tool as change-point analysis which is able to detect discontinuities and regime shifts in climate was used

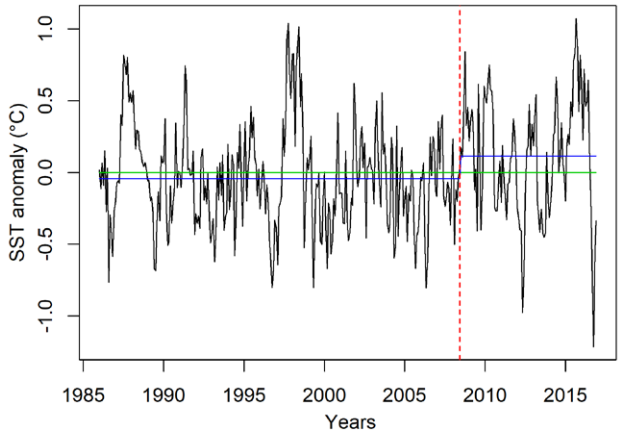


Fig.1. SST anomaly on southwest coast of India

in time series data of SST anomaly in R3.4.4 software for windows. The result showed a significantly high SST anomaly after 2008 (Fig.1).

## Spatial and seasonal analysis of catch

The fishery trends of genus *Stolephorus* only from the southwest coast of India was used because it dominated the anchovy fisheries of the region. Monthly data on gear wise landings of *Stolephorus* from 1997 to 2017 and the fishing effort expended in terms of operational hour for all gears were obtained from the National Marine Fishery Resources Data Centre (NMFDC) of the ICAR-Central Marine Fisheries Research Institute (CMFRI). A standardized catch per hour (CPH) for all strata was estimated by applying the gear standardization method for multi-species and multi-gear fisheries (Bharti *et. al*., 2019). For the study of spatial variation in *Stolephorus* fisheries, the entire southwest coast of India was converted into three strata. The first stratum (ST_1) was considered between 8° to 10.2° N, second stratum (ST_2) was between 10.2° to 13° N and third stratum (ST_3) was between 13° to 16° N (Fig. 2). To observe seasonal variation, the monthly CPH again was grouped into three seasons viz. pre-monsoon (February-May; PRM), monsoon (June-September, MON) and post-monsoon (October-January, POM).

The spatial distribution of *Stolephorus* was conducted with comparison of the trend of CPH at three strata (Fig. 3). The highest CPH was observed along ST_1 before 2007, but later, CPH at ST_1 became lowest as a result of its decreasing trend. In contrast ST_3 showed

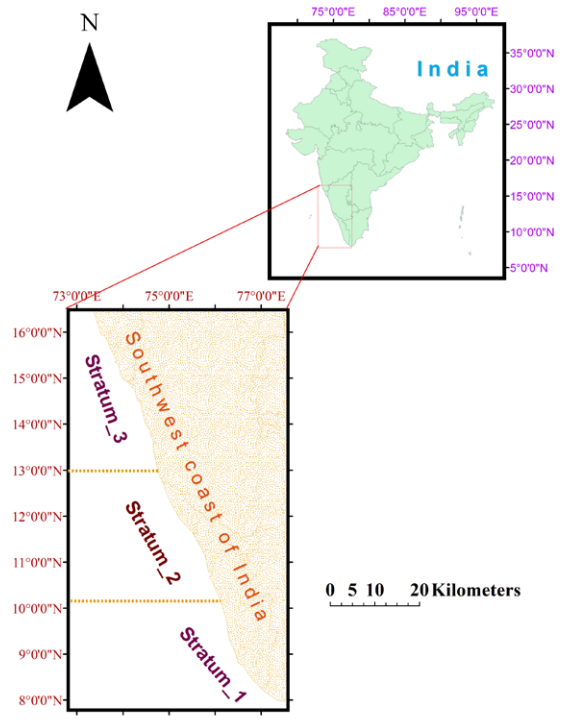


Fig. 2. Map of southwest coast of India indicating strata used

a continuously increasing trend with rising CPH trend after 2010. Due to increasing trend since starting of study period, CPH along ST_3 became highest among all strata after 2008. ST_2 also showed an increasing trend after 2005. Correlation analysis for CPH among all three strata showed a significantly positive correlation (0.77) between ST_2 and ST_3 (Table 1). The CPH of *Stolephorus* had increasing trend at both ST_2 and ST_3, but the same had decreasing trend at ST_1. The trend of CPH during three seasons was analyzed to observe the seasonal shift (Fig.4) which showed the maximum CPH

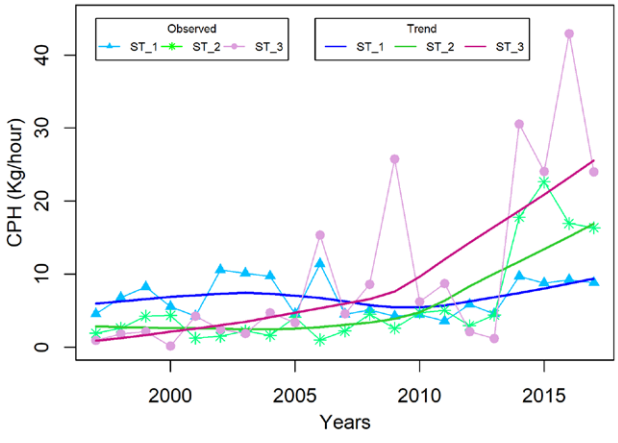


Fig. 3. Stratum wise trend of CPH for *Stolephorus* spp.

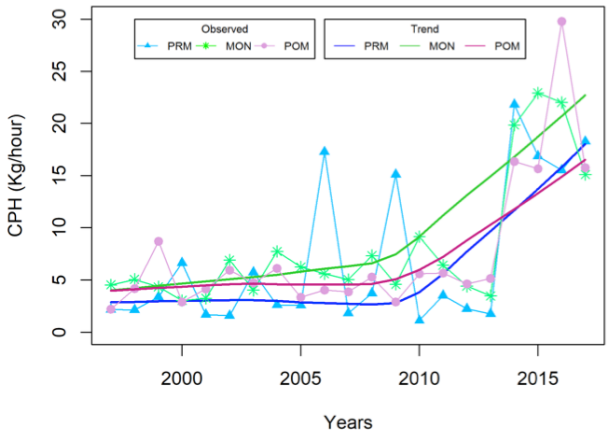


Fig. 4. Seasonal trend of CPH for *Stolephorus* spp.

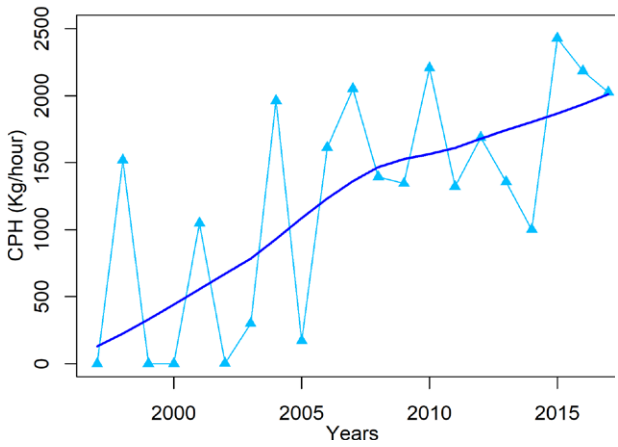


Fig. 5. CPH trend of MRS

during MON. The lowest CPH was always during PRM except 2015 onward, where its CPH was higher than POM. However, all three seasons showed increasing trend in CPH after 2010 onwards. The seasonal trend of CPH showed a significantly positive correlation among each other (Table 1).

## Gear wise analysis of catch

All gears operated targeting *Stolephorus* were classified into five major generic gear categories viz. mechanized ring seine (MRS), mechanized trawl net (MTN), outboard ring seine (OBRS), outboard trawl net (OBTN) and non-mechanized gears (NM). Gear wise CPH along each stratum was also estimated by dividing standardized effort of a particular gear into the total landing of *Stolephorus* in the same gear. The time series CPH of MRS showed a continuously increasing trend while that for MTN had an upward trend since 2010 (Figs. 5 and 6). On the other hand, the CPH of OBRS (Fig. 6), OBTN and NM (Fig. 7), which are operated in comparatively lower depth had a decreasing trend. The correlation analysis for CPH among the different gears did not show any significant correlation during the study period.

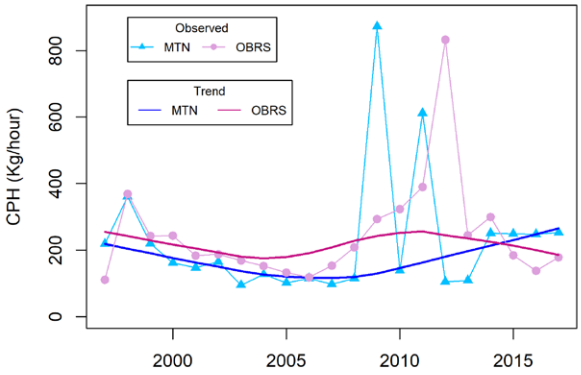


Fig. 6. CPH trend of MTN and OBRS

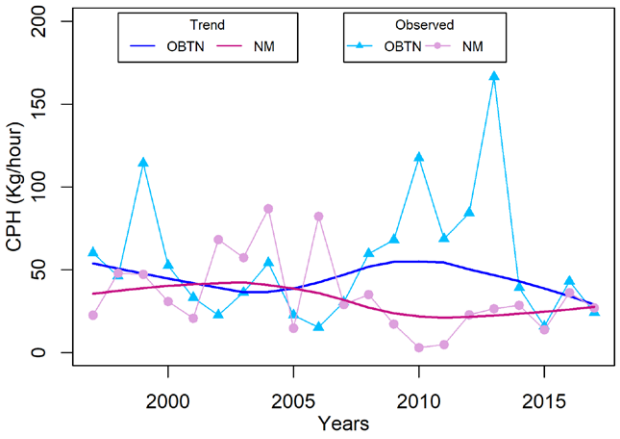


Fig.7. CPH trend of OBTN and NM

Table 1. Correlation of spatial and seasonal change in CPH of *Stolephorus* spp.

| | Strata | | | | Seasons | | |
|---|---|---|---|---|---|---|---|
| | ST_1 | ST_2 | ST_3 | | PRM | MON | POM |
| ST_1 | 1.00 | 0.32 | 0.34 | PRM | 1.00 | 0.71*** | 0.63*** |
| ST_2 | | 1.00 | 0.77*** | MON | | 1.00 | 0.89*** |
| ST_3 | | | 1.00 | POM | | | 1.00 |

***0.001 level of significance

## Life cycle

The life cycle model of *Stolephorus* was derived based on the conceptual knowledge on its biological attributes (Fig. 8). The assemblage of *Stolephorus* on the southwest coast of India starts by October, when the temperature becomes slightly higher after cessation of southwest monsoon. After entering in the southwest region, it spreads in entire ST_1 area by November. Its movement is continued towards the northern region with decreasing of temperature on the onset of the winter season at the northern region of the southwest coast of India, therefore this decreased temperature facilitate it to continue northward migration and finally reaches up to ST_3 by the end of February. As the temperature starts to increase at ST_3 after onset of summer season, it forces them to move again towards south. By the end of May, they again get aggregated at ST_2 and ST_1. After May, the upwelling phenomenon appears at the southwest coast, which reduces the both temperature and dissolved oxygen at surface water. During these adverse oceanic conditions, *Stolephorus* assembles in the southeast region. However, the rising SST under global warming phenomenon, apparently is forcing it to move to southwest coast comparatively earlier in the recent past period as indicated by a sharp increasing trend in CPH of *Stolephorus* during POM after 2008 in this study. To minimize the adverse effect of global warming, they might have utilized both possibilities by extending their existence vertically in deeper water and horizontally towards the northern region. This might be the reason for the upward trend of CPH in strata ST_2 and ST_3, while CPH of ST_1 was decreased after 2008.

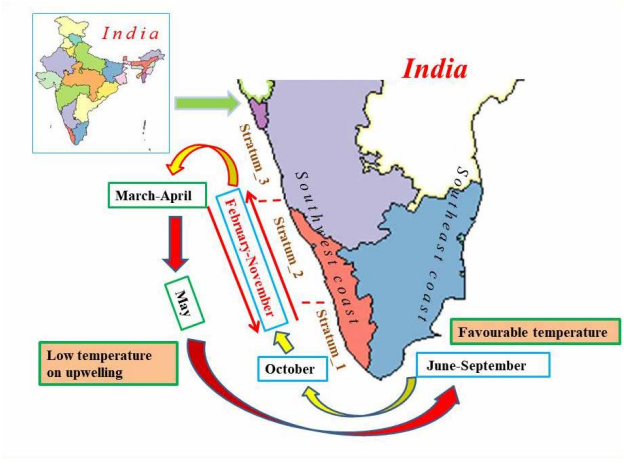


Fig. 8. Life cycle model for *Stolephorus* spp.

This increasing of *Stolephorus* population from southern to northern region emerges from a significant positive correlation between ST_2 and ST_3.Normally, the lowest CPH was observed during PRM which is the summer season on southwest coast, but with rising SST, the CPH also showed an increasing trend during this period. It could mean that *Stolephorus* tends to remain on southwest coast during the pre-monsoon season, but it might have shifted into deeper water to avoid high temperature on both southwest and southeast coastal region due to rising SST. Shifting to deeper water might be the reason for continuously increasing of CPH in mechanized gears that are operated in deeper water region while in the same period CPH of motorized and non-mechanized gears has decreased. Therefore, a shifting of *Stolephorus* distribution in three dimensions-vertical shift to deeper water, horizontal shifting toward northern region and also seasonal shifting under impact of climate change is recorded.

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# First report on induced spawning of *Siganus vermiculatus* in India

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## Abstract

Siganids are widely distributed to Indo-West Pacific region and the *Siganus vermiculatus* (Maze rabbit fish/ Vermiculated spinefoot) can reach sizes that weigh up 2.3 kg each. It is a species of great aquaculture importance and hence breeding and seed production protocols are necessary. A major breakthrough in the seed production of *Siganus vermiculatus* by inducing the fishes to spawn under controlled conditions with Human Chorionic Gonadotropin (hCG) during the first quarter of the lunar cycle is reported. The hatchery processes and early larval stages are described.

***Keywords**: Rabbitfish, Siganus vermiculatus, induced spawning, India*

## Introduction

Among Rabbit fishes or siganids (family Siganidae) the *Siganus vermiculatus* (Maze rabbit fish/Vermiculated spinefoot) can reach sizes that weigh up 2.3 kg each. *S. vermiculatus* has good aquaculture potential due to their fast growth, tolerance to fluctuating environmental conditions, crowding and handling. A major breakthrough was achieved on 15.3.2019 in the seed production of *Siganus vermiculatus* by inducing the fishes to spawn under controlled conditions with Human Chorionic Gonadotropin (hCG) injection for first time in India as a part of All India Network Project on Mariculture. The process of broodstock development and rearing of the early larval stages is described.

## Broodstock development and larval rearing

The wild collected *Siganus vermiculatus* (150-800 g) from Ratnagiri were reared in broodstock development cages of the marine cage farm of ICAR-CMFRI in Karwar, over a 4 month holding period prior to induced breeding. The fishes were fed with formulated pellet feed enriched with cod liver oil and Vitamin E during this period. A breeding pair consisting of female fish (31 cm, 750 g) with egg diameter above 400 microns and male fish (32 cm, 800g) with thick oozing milt were maintained in 3 ton FRP tanks in the hatchery and treated with a similar feeding regime as in the cage farm site.

Fig. 1. *Siganus vermiculatus*

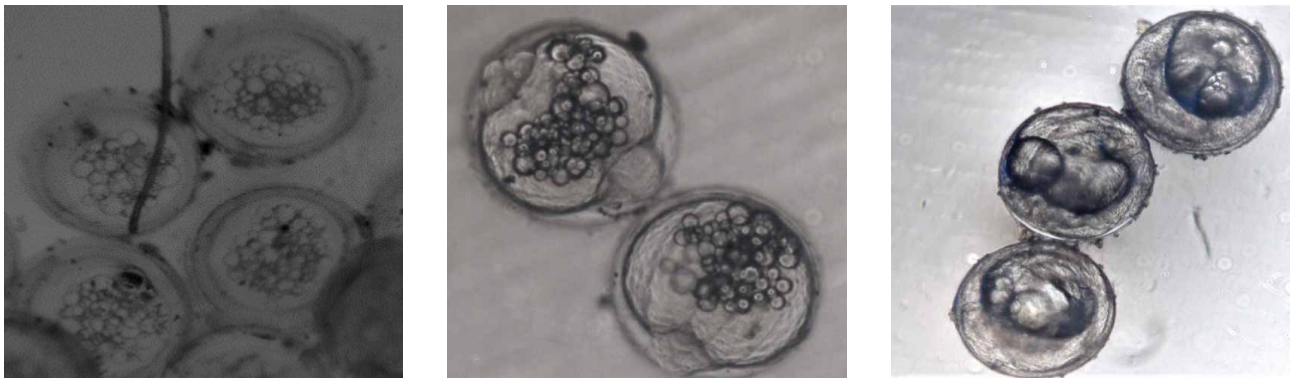

Fig. 2. Embryonic developmental stages of *S.vermiculatus*

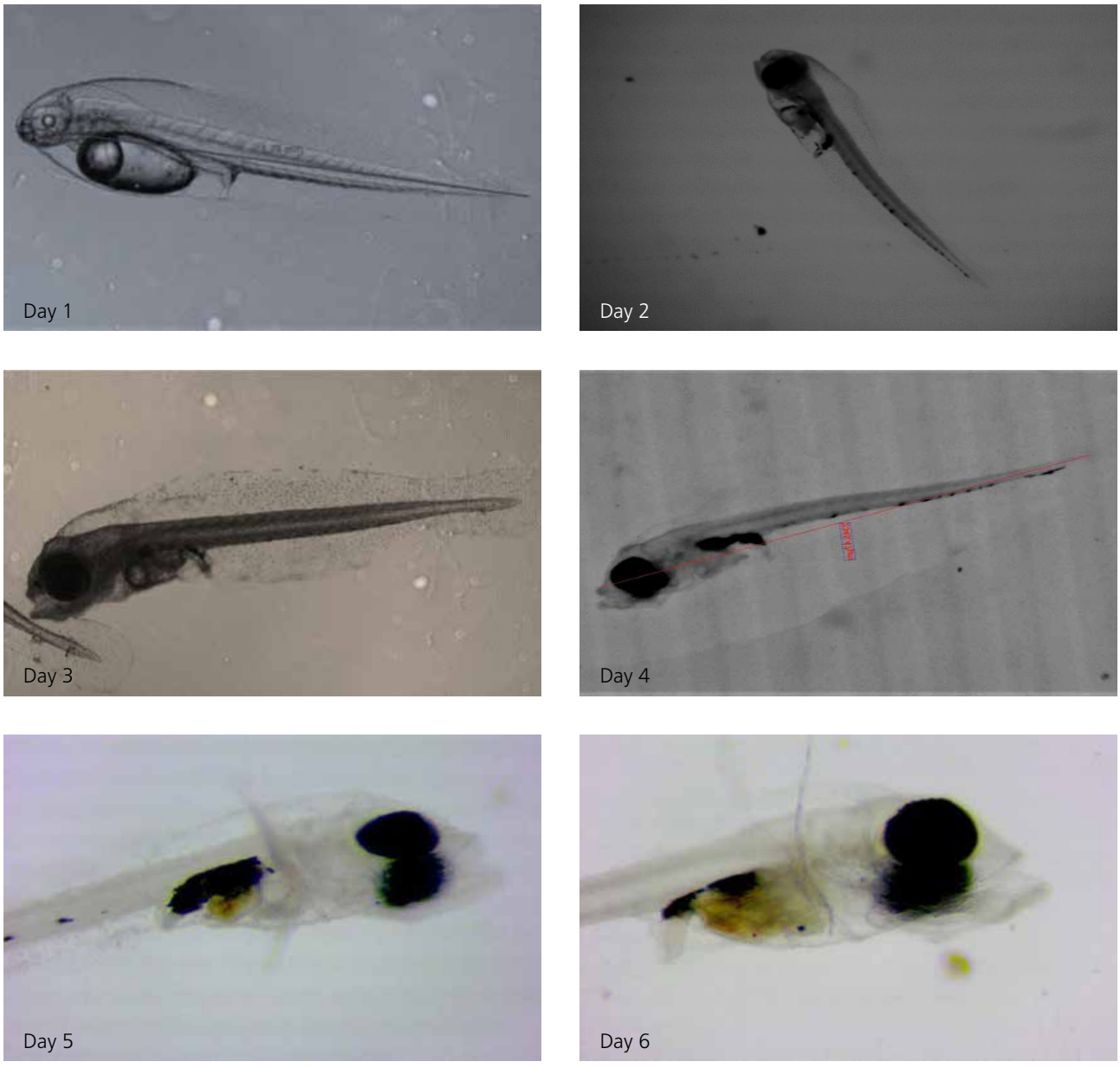


Fig. 3. Larval developmental stages (Day 1-6) of *S.vermiculatus*

The breeding pair was intramuscularly injected with hCG @ 500 IU and 200 IU for female and male respectively, at 16:00hrs for 3 days during the first quarter of lunar cycle following a 24 hour interval. As the eggs of *Siganus* are demersal and adhesive, after the third injection fishes were released back inside the nylon hapa in FRP tank for egg attachment. Spawning was observed after 21 hours and 30 minutes of the final dose of injection. The adhesive demersal spherical fertilized eggs (average egg size: 560 $\mu$) were found attached to the walls of the hapa. The nylon hapa with fertilized eggs were shifted to another 3 ton FRP tank filled with seawater of 28 ppt salinity and 27-29°C temperature for embryonic development (Fig. 2). The initial hatchlings were observed inside the nylon hapa after 25 hours and 30 minutes of spawning. The newly hatched larvae measured 1.713 mm to 1.783 mm in size with yolk sac (420 $\mu$) and oil globule (220 $\mu$). Mouth opening (120 $\mu$) was observed on third day after hatching. Larval rearing (Fig. 3) was done upto 8 day post hatching (8DPH) using pure cultures of marine microalgae, copepods and rotifers (Table 1).

*S. vermiculatus* fetch higher market price than other siganids due to their consumer preference. They can be fed low protein feeds due to their herbivorous feeding behaviour and also be used to control net fouling in sea cages due their grazing behaviour on algae. After the successful development of a complete larval rearing protocol for *S. vermiculatus* described here, it could emerge as a valuable candidate species for cage culture.

Table 1. Feeding schedule followed for the larval rearing

| | 1 DPH | 2 DPH | 3 DPH | 4 DPH | 5 DPH | 6 DPH | 7 DPH | 8 DPH |
|---|---|---|---|---|---|---|---|---|
| Marine microalgae (*Isochrysis, Nanochlorpsis, Chlorella*) | | | | | | | | |
| *Apocyclops cmfri* (Loka & Santhosh, 2017) | | | | | | | | |
| *Colurella* sp. | | | | | | | | |
| *Brachionus rotundiformis* | | | | | | | | |

# Incidence of amyloodiniosis in snubnose pompano juveniles and its effective control in marine hatchery

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## Abstract

Amyloodiniosis infection in snubnose pompano was reported in marine fish hatcheries of ICAR-CMFRI during preparation for certain feeding experiments in this fish that is of aquaculture importance. The control and elimination of *Amyloodinium* sp. from the hatchery system is a herculean but vital task and several methods were carried out following the infection.These were evaluated for their usefulness and are reported below.

***Keywords****: Snubnose pompano, Amyloodinium ocellatum, amyloodiniosis, control measures*

Five hundred juveniles of Snubnose pompano (*Trachinotus blochii*) with a weight range of 0.5-1.0 g were brought from Marine finfish hatchery of ICAR-Mandapam Regional Centre of CMFRI for fish nutrition experiments. The juveniles were stocked in 10 rectangular FRP tanks of one ton capacity each at the rate of 50 numbers $m^{-3}$. In order to ameliorate the handling stress the fishes were given 10 ppm KMnO4 dip treatment for 2 minutes before stocking. The fishes were initially stocked in sea water of 25 ppt salinity and gradually acclimatized to 15 ppt salinity for acclimation period of 30 days. In the acclimation tanks, water exchange was done at 100% on daily basis and the fishes were fed to apparent satiation with a diet developed for snubnose pompano containing 40% crude protein and 6% crude fat. After acclimatization period, 150 fishes were stocked in 5 re-circulatory tanks each of 1 ton capacity and connected to a biofilter assembly. During the course of the rearing period the fishes were heavily infested with the dinoflagellate, *Amyloodinium ocellatum.*

The infected fishes frequently rubbed its body on the walls and bottom of the tank. In the initial stage of infestation, fishes consumed the feed normally but showed negative growth in terms of muscle accretion and hence, became emaciated (Fig. 1). As the infestation advanced, the fishes avoided routine feeding, became lethargic and congregated near air stones incessantly. Eventually, 40% mortality was observed within 5 to 6 days of advanced infestation.

The infected fishes were dissected and the gill samples were collected. The gills of the fishes were pale in colour with copious amount of mucus. The gill samples were stained with haematoxylin and examined under stereomicroscope that showed the presence of heavy infestation of trophont stage of *A. ocellatum.* As the trophonts were predominantly attached in the gill filaments (Fig. 2) by anchor like roots and covers the gill filaments, it significantly reduces the uptake of oxygen through gills. This stage of *A. ocellatum* infection is known

as *amyloodiniosis* or marine velvet disease. The parasitic trophont matures about 80-100 $\mu$ in size.

The control and elimination of *Amyloodinium* sp. from the hatchery system is a herculean task as the trophonts detaches from the gills and forms encysts (tomont stage) which settles at the bottom of the tank and divides internally to form an infective stages (dinospores) that actively swim in the water column in search of new hosts. There is no specific aquaculture drug presently available for its effective control. A combination of drugs/ chemicals may protect the fish to some extent. The infestation can be curbed to a certain extent by multidrug administration and proper water treatment (Ozonization, UV sterilization, freshwater dip, adequate water exchange and reducing the salinity of water (up to 5 g $L^{-1}$).

The infected fishes were primarily treated with formalin at the rate of 15 ppm as bath treatment for 3 consecutive days which was found to be effective during the course of infection with 100 % water exchange every day. As a secondary treatment, chloroquine phosphate (Lariago 250 mg tablets; Ipca Laboratories Pvt. Ltd.) was given at the rate of 10 ppm as a bath treatment along with formalin bath treatment for 3 consecutive days and this was effective against *amyloodiniosis*. Copper sulphate at the rate of 0.2 ppm is reported for treating *Amyloodinium* sp. in marine ornamental fishes. Therefore, in the present study some fishes were treated with copper sulphate at the rate of 0.2 ppm but it was not as effective as other drugs in snubnose pompano. Use of copper sulphate is also not advisable in food fish due to its ichthyotoxic / algicidal nature and accidentally if the level goes beyond 0.2 ppm may cause mass mortality of fishes. Besides other methods, freshwater dip treatment is an effective option during the initial stages of infestation. The fish with initial stages of infestation responded to the treatment but advanced stage of infested fish succumbed to acute mortality. Further in the bio-filter connected re-circulatory tanks, the fishes were heavily infested than in the rearing tanks without biofilter due to the reason that the bio-filter retains the encysted tomonts that later proliferate into dinospores. Hence, installation of ozonizers and UV sterilizers for intake seawater treatment along with periodical cleaning of rearing tanks with liquid bleach may keep away the *amyloodiniosis* infections from the marine fish hatchery.

Fig. 1. *Amyloodinium* sp. infected juveniles of *Trachinotus blochii* showing emaciated body

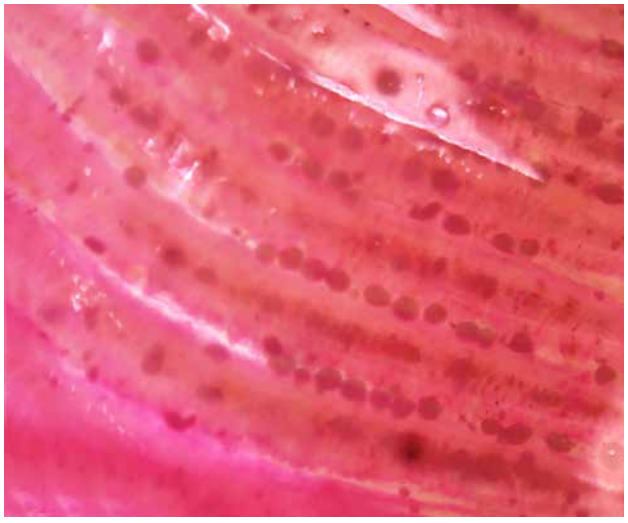

Fig. 2. Gills with trophont stage of *A. ocellatum* stained with Haematoxylin and magnified at 5X under stereomicroscope

# Fishery for cephalopods using Fish Aggregating Device off Blangad in Kerala

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Fish Aggregating Device (FAD) is being deployed off Blangad a small coastal village in Chavakkad, Thrissur district of Kerala, for catching squids and cuttlefishes. The FADs are made up of coconut spadix (locally known as *Kolanjil*), plastic bottles, nylon ropes, pieces of fishing nets and sacks containing large quantities of sand. This structure is locally known as *Norumbu* and fishermen from Colachel and Kanyakumari are mainly involved with this activity. The coconut spadix tied with nylon ropes and plastic bottles as float have sacks filled with sand as anchors (Figs. 1 & 2). This structure errected in the sea in identified sites at a distance of 20-44 km from shore and having 30-50 fathom depth, acts as an aggregating device, especially for cephalopods. The fishers record its position on their Global Position System (GPS) unit and after 5 days arrive to operate hooks & lines (Fig.3). Fishing season is from October-May and during the peak season, around 200 fibre boats are operating from Blangad. Most of the boats are fitted with 2 numbers of 9 hp outboard engines. A tractor is used for hauling the boat to the beach (Fig.4).

The fishing activities start early in the morning and return to the shore by around 5pm in the evening. The trade of the catch of fish and cephalopods lasts up to 9 pm. The landings were regularly monitored from October 2018 to March 2019. Sampling and field observations were conducted in the evening to assess the catch composition, size, and the number of boats arrived. Details about the method of setting up FADs in the sea was collected by interviewing fishermen. The average number of cuttlefishes a single boat fetches was recorded by monitoring landings from all boats over the study period which was found to be around 100. Their weight was also noted. The cuttlefishes were found to be in ripe condition. During the study period, the only species recorded was *Sepia*

Fig.1. Loading *Kolanjil* in the boat

Fig.2. Floats used for FAD

Fig.3. Hook used for fishing

Fig.4. Tractor used for hauling the boat with catches

*pharaonis* weighing about 3 kg each (Fig.5). A number of its juveniles were also noticed in the landings, which weighed 110- 230 gm each (Fig.6).

The hooks & lines are operating not only in the regions where these FADs are installed but in other areas also. Thus, the landings at Blangad consist of cephalopods and fishes with the former exclusively from the FADs and latter that primarily includes large pelagics like seerfish, tunas, barracudas, mackerel, carangids and bulls eyes from other areas. The trend in landings of cephalopods and fishes in hooks & lines at Blangad based on estimated fish landings data during 2009-2018 that was collected by the Fishery Resources Assessment Division of ICAR-CMFRI is indicated in Fig.7. Hooks and line fishery of cuttlefish at Blangad was reported earlier by Baby (2011).

The landings of cephalopods varied from 5868 t in 2010 to 386 t in 2017 and the overall share of cephalopods in total landings by hooks & lines was 81% during 2009-2018. The cephalopods are being sold to local agents @ ₹350/kg and is meant for export. Over the years, this fishery is showing signs of decline. Trapping the cuttlefishes which seasonally migrate to inshore waters for spawning can be seen as a reason for the dwindling population of this resource in the region. The moored

Fig.5. Cuttlefish catch

Fig.6. Catch showing the share of juveniles

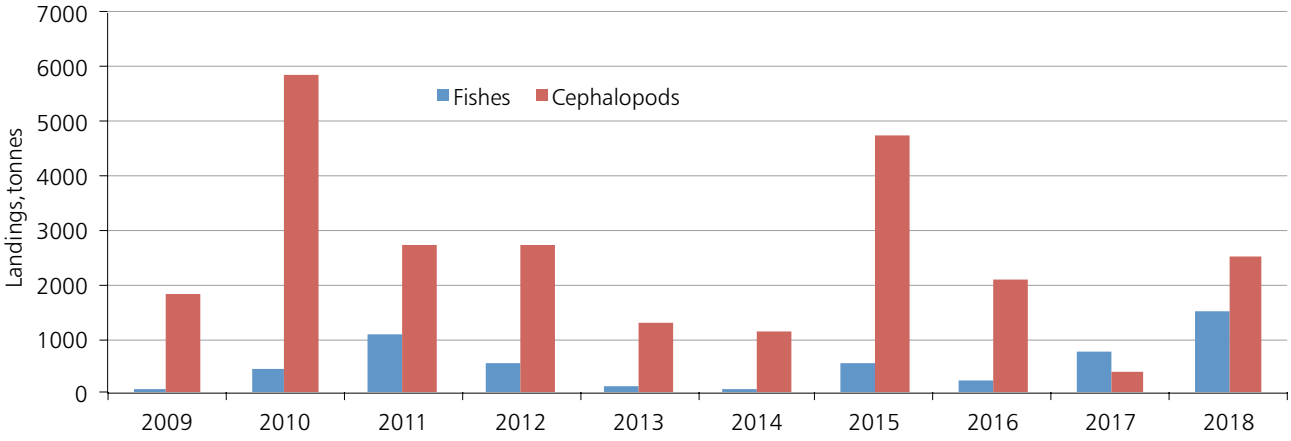


Fig.7. Yearwise landings by Hooks & lines at Blangad during 2009-2018

aggregating devices offer a suitable place to spawn and in that attempt they are easily caught in the hook. Further, since these FADs are installed in rocky areas where safe places are available for fishes to breed, those shelters will be destroyed by depositing tonnes of sand which is used for anchoring the device. Moreover, by this method of fishing, lot of plastic bottles/other plastic items, nylon ropes and net pieces will also be deposited in the sea causing pollution in the environment. This kind of fishing for cephalopods has been banned in Karnataka (Geetha *et al*.,2015) and also recently in Kerala under the Marine Fisheries Regulations Act framework of these maritime states.

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Brief Communications

# Self imposed ban by local fisherfolk for the conservation of brown mussel

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Brown mussel, *Perna indica* is one of the important bivalve resources off Thiruvananthapuram coast and mussel beds located in the Vizhinjam-Kovalam region is the main area targetted by fishers. This organized bivalve fishery supports the livelihoods around 300 fishermen. Fishing is carried out throughout the year except during monsoon season that starts early in the morning before 6 am and landing at shore by 9 am.

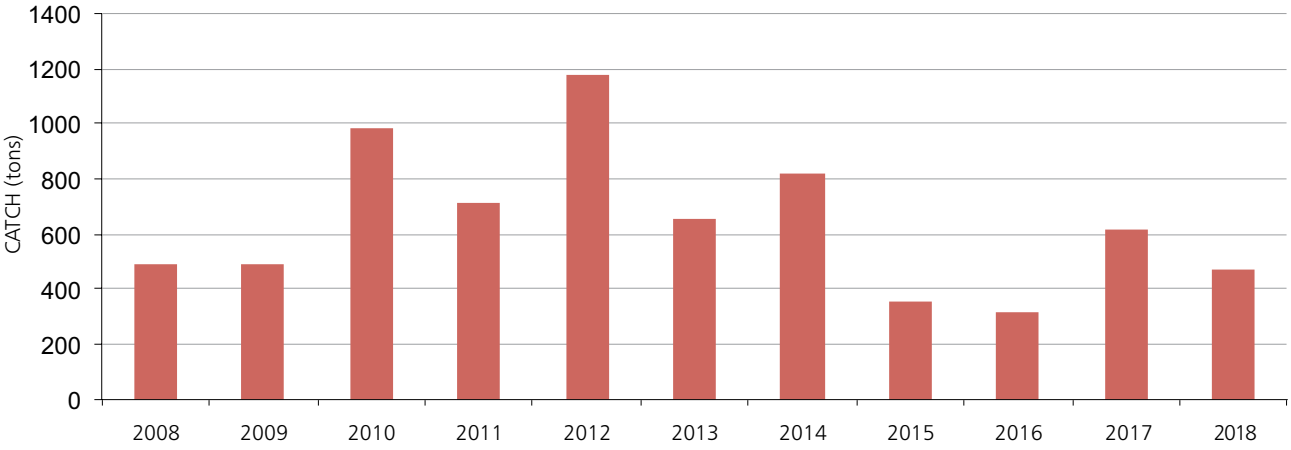


Fig.1. Brown mussel landings from 2008-2018 from mussel beds in Vizhinjam-Kovalam region

The mussel landing did not follow any definite pattern except the decadal highest landing of 1181 tons during the year 2012 and the lowest of 316 t in 2016 (Fig.1). Because of the lower catches in recent years compared to the 2010-2014 period and higher prices fetched by larger mussels (*Muthuka chippi*) fishermen themselves came to a conclusion that collection of small mussels along with the adults during the peak fishing season could be the reason for reduction of mussel landings in last 2 to 3 years. Spawning season of brown mussel in Vizhinjam-Kovalam beds begins in May and extends till July. Since availability of small mussels coincides with the peak fishing season (September-November) highest number of small sized mussels were collected during the post-monsoon season. Spat of brown mussel of 2 mm size is observed from July onwards in the mussel beds.

Therefore the decision was taken by the fisherman group (Chippee committee) that fishermen should not harvest small size mussels in the Vizhinjam-Kovalam mussel beds and they also imposed penalties for those violating the restrictions. A poster with following rules imposed by the local body in vernacular was put up in advance in February, 2019 (Fig. 2). The following rules were put forward for all concerned fishers and stakeholders to follow.

1. Fishermen who collect small mussels should pay ₹10000 as penalty.
2. People who buy small mussels also have to pay ₹5000 as penalty.
3. Small mussels should not be harvested for consumption.
4. Canoes engaged in mussel fishing should carry the catch in the same fishing craft and catch should not be transferred to other fishing units, else they are penalized for ₹2000
5. Fishermen who go for lobster fishing on Thursdays cannot engage in mussel fishery for one week.
6. Fishermen cannot engage in mussel fishing from any area on Friday, if they do so they will be prohibited from collecting mussels in this area.
7. Mussels collected from other areas should not be sold or kept here in the seawater at the landing centre for


Fig.2. Poster with self-imposed regulations of the mussel fishers

selling, if someone does so he/she will not be allowed to do the job here.

These rules should be followed and obeyed
Mussel committee: Reg.No.TVM/TC.1514/2014

Since it is a voluntary action by fisher folk, so far no single violation of rules was registered and therefore no fine was collected from the fishermen. The ban on fishing small mussels increase the catches and improve the returns of the fisherfolk as the mussels are allowed to grow to larger sizes, fetching higher prices. It makes the fishery sustainable as it gives a chance for the mussel seeds to grow and spawn at least once and bring up the next generation of mussels.

Brief Communications

# Marine turtle conservation programs in villages of Ratnagiri, Maharashtra

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Maharashtra is active in sea turtle conservation and its citizen actions with support of forest department are highly commendable particularly in some regions of southern Maharashtra. During the surveys conducted at Harne and Kolthare villages of Ratnagiri in March 2019 it was observed that local volunteers known as "*Kasav Mitra*" identified by Forest Department, in Ratnagiri District of Maharashtra are undertaking beach patrolling and relocating the eggs to secured enclosures for multiple reasons such as the egg sites being too close to tide water level, beaches open to public that can result in eggs being unknowingly crushed by beachgoers, or dug up by dogs or targeted poaching.

On this coast, major nesting period of Olive Ridley (*Lepidochelys olivacea*) is between November to April every year. *Kasav Mitra* patrols the beach day and night for turtle nest. They dig out the eggs and move them into artificially made nest on the same beach. *In situ* preservation is also done if nest is found away from high tide water (Figs.1-2). In Anjarle Village near the Harne Port 8 nests were preserved in artificial hatchery on same seashore. During the survey on 22.03.2019 and 23.03.2019 in Kolthare Village, 23 nests were observed of which 10 were preserved *in situ* by setting wooden poles around the nest to protect the eggs from predatory dogs and jackals around. The eggs hatch after

Fig.1. *In situ* nest at Kolthare


Fig.2. Artficially made nest at Anjarle

Fig.3. Hatchlings of Olive ridley

45 to 65 days incubation (Fig.3). *Sahyadri Nisarga Mitra*, Chiplun (Ratnagiri) and Forest Department of Maharashtra (Ratnagiri District) plays an important role in guiding local volunteers to protect and preserve this turtle. On 28.03.2019, a visit was made to this center to collect data of sea turtle hatchlings released to sea till date (Table 1).

Table 1. Details of sea turtle hatching collected

| Village | Number of nests | Number of eggs protected | Number of hatchlings released |
|---|---|---|---|
| Anjarle Village | First Nest on : 01.02.2019<br>Last Nest on: 26.02.2019<br>Total Nests found 8 | 532 | 120 |
| Kolthare Village | First Nest on 15.01.2019<br>Last Nest on 20.03.2019<br>Total Nests found 23 | 870 + *in situ* eggs | 168 |

Brief Communications

# Report on a stranded sea cow, *Dugong dugon* in the Gulf of Mannar coast

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On 31 March 2019, an adult dead female sea cow (*Dugong dugon*) measuring more than three meters of total length got stranded along the Gulf of Mannar coast at Gandhi Nagar, Mandapam, Ramanathapuram district, Tamil Nadu (09º 27' 6658" N; 79º 15' 0459" E). The morphometric details of the female whale that was weighing approximately 350 kg is given in Table 1. The specimen had relatively robust body with loss of almost one third of the ventral skin along with blubber from the thoracic and abdominal region of the body. There were significant cut wounds present on the dorsal as well as lateral sides of the body. The internal organs did not reveal any significant abnormalities for the cause of death. Based on the body condition and external injuries it can be concluded that the cause of death might be due to attempted hunting. Dugongs fall in schedule 1 of the Indian Wildlife (Protection) Act whose hunting is banned and poachers are liable for punishment.

Fig.4. Necropsy performed on stranded sea cow

Table 1: Morphometric details of the sea cow washed ashore at Mandapam, Tamil Nadu

| Morphometric parameters | Measurement (cm) |
|---|---|
| Tip of snout to fluke notch | 344 |
| Tip of snout to center of anus | 246 |
| Tip of snout to center of genital aperture | 230 |
| Tip of snout to center of umbilicus | 191 |
| Tip of snout to anterior insertion of flipper | 81 |
| Tip of snout to center of eye | 42 |
| Tip of snout to external ear | 54 |
| Center of eye to ear | 12 |
| Distance between centers of eyes | 36 |
| Center of eye to center of nostril (same side) | 23 |
| Flipper length, anterior insertion to tip | 60 |
| Flipper length, axilla to tip | 45 |
| Maximum width of flipper | 30 |
| Girth at umbilicus | 216 |
| Girth at axilla | 163 |
| Length, Muzzle (anterio-posterior) | 26 |
| Breadth, Muzzle (lateral) | 24 |
| Length, Chin | 17 |
| Breadth, Chin | 20 |

Brief Communications

# Heavy landings of bull sharks in Digha, West Bengal

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Elasmobranchs (sharks, rays, skates and guitarfishes) form one of the important commercial fisheries of West Bengal. They are not targeted but usually occur as by-catch and due to demand for sharks in the national and international markets are remunerative. West Bengal contributes 10.51% to the total elasmobranch landing of India. The local demand for shark or rays is very little but fish trading and processing units which supply such products to distant places such as Kochi, Chennai, Visakhapatnam and even to the international market procure sharks from the fishermen.

In Digha the landing of bull sharks usually increases during the winter time. A total of 56 numbers of bull sharks in length range of 95-295 cm (total length) weighing between 9 to 335 kg each were landed at

Digha Mohana fish landing centre, West Bengal, India during October 2018 to March, 2019.Of these, 35 were males and 21 were females which were all adults and mostly mature. The bull sharks are amphidromous as they are born in freshwater and estuaries after which the juveniles enter marine environment for growing into adults and finally the adults migrate back into freshwater and estuary to breed and repeat the cycle. This also indicates that the adults and juveniles show visible ecological and geographical segregation which could be one of the reasons for dominance of adults in the marine fish landings. By interviewing fishermen in the multiday trawlers it was revealed that the catches came from the fishing areas of Rakhyaskhali and Bokhali, south-east of Digha approximately 55-60 km away from the shore. The trawlers (approximately 55 feet OAL) having engine power of 420 hp and 3000 kg fish hold capacity are usually operated for 6-8 days at a depth of 20-50 m. Such trawlers usually bring two to three numbers of bull sharks while targeting hilsha, pomfrets, croakers and shrimps. The whole bull sharks are sold to the traders at a price range of ₹150-250 per kg at the auction market. The meat is exported in frozen form and fins are usually dried.

Brief Communications

# Multiple carcasses of Olive Ridleys along Malvan Beach

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The Olive Ridley turtle (*Lepidochelys olivacea*) is protected under the Indian Wildlife (Protection) Act, 1972. Maharashtra government along with NGOs are undertaking several efforts in conservation of sea turtles along the coast. There is a state sponsored incentive program of ₹500 for locating and sharing information with forest officials. Malvan coast in Sindhudurg district of Maharashtra is known for turtle and fisheries interactions. Occasional turtle nestings can be seen between November to April. During 20.03.2019 to 27.03.2019, a total of six adult turtle carcasses were observed in the 5 km stretch of beaches between Dandi and Tarkarli beach. First specimen was observed on Dandi beach near Malvan on 20.03.2019. Subsequently, carcasses of two turtles were found on the beach of Wairi and Tarkarli fishing villages located in southern Malvan. Most of the specimens were partially decomposed even though specimen was identified as Olive ridley from the intact scute pattern on carapace. Morphometric characteristics measured to possible extent are detailed. Carapace length of specimens ranged from 64 to 71 cm. No specimen was found entangled in ghost net or with any injury marks.

Morphometric measurements (in cm) of Olive Ridley carcasses located at various beaches

| Morphometric measurements | Dandi | Wairi | Tarkarli |
|---|---|---|---|
| Carapace length (Straight) | 65 | 71 | 64 |
| Carapace width | 52 | 63 | 50 |
| Head length | - | 24 | 27 |
| Head width | - | 14 | 15 |
| Tail length | - | 13 | 14 |

Specimen 1. Dandi beach

Specimen 2. Wairi beach

Specimen 3. Tarkarli beach

During the nesting season many turtles approaching beach for nesting are often caught in fishing gears, though mostly released due to high awareness among the fishers. The chances of injuries affecting the swimming capacity and stranding on the beaches later, resulting in death is high. Though fishermen are aware of the conservation status of animals and supporting actions, they voice the opinion that turtles are increasing in the coastal waters and often affecting the fishing activities.

Brief Communications

# Artisanal fishing methods along the Vizhinjam Coast, Kerala

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Vizhinjam Landing Centre (8° 22' 30" N, 76° 59' 15" E), is one of the important fish landing centres in Kerala capable where fish landings occur all over the year by employing crafts and gears according to the seasonal requirements and availability of fishes. Primarily carried out by traditional crafts and gears, fitted with outboard engines, vessels fitted with inboard engines and other modern gears are not able to operate along the coast due to patchy rocks and steep sloping continental shelf of this region. During the last decade, there was a complete transition from the wooden crafts to fibre boats which made crafts lighter and in turn enabled increase in the speeds of the fishing vessels. Even some of the catamarans which the government had given free to fishers after the 2004 Tsunami, remain at shore. Most of the traditional crafts along the coast ranged from 25 to 40 feet overall length (OAL). Two outboard engines with 9.9 HP each are used for propulsion. Fishers disclosed that after the Ockhi Cyclone in December 2017, fishing grounds haved changed and there is a conspicuous reduction in fish availability. Drift gillnet forms the major gear in fishing operation along the coast followed by mechanised hooks and line and boat seines.. The details of some of the artisanal gears and its mode of operation are given below.

Hook and line fishing: Hand line (*Aachil*) is characterized by the main line of nylon monofilament twines of length ranging from 15 to 20 m with many branch lines tied at intervals of 1.5 m on the mainline and having hooks at

Fig.1. Hand line hooks (with artificial bait) and branch lines

Fig.2. Squid jigs

their distal end (Fig.1). At the end of the main line, 0.5 kg iron sinker is attached. The 15 m longline is used during night the 7 m longline during daytime. The monofilament twines are categorized as numbers 40, 60, 80 etc. based on their thickness, with smaller the number the thicker the twine. For day fishing, number 80 main lines with number 60 branch line is used, while for night fishing number 30 is used for both main and branch lines. Similarly, different types of hooks categorized into numbers are used. Hooks used for day fishing range from number 8 to 13 while hook number 15 is used for night fishing. The hand lines are operated from 28-foot fiberglass coated plywood boats (FPB) fitted with 9.9 HP outboard (usually two) engines. Three to four fishermen go for fishing and each of them operates a hand line. Fuel consumption is estimated at about 7 litres per hour with consumption of about 10 litres of kerosene. Apart from FRP boats, catamarans are also employed for the hand line operations. Catamarans made by 4 pieces of 6 m long logs and powered by traditional sail (cotton) with a bamboo pole mast and small outboard engines are in vogue. One to three fishermen go for handline fishing in catamarans with operations carried out throughout the year.

Hand lines with jigs for squid and cuttlefish are made up of monofilament twines number 80 (mainline) having 28 fathoms length with1 m of number 60 branch attached to it. Six to ten branch lines with jigs (Fig.2) are tied at an interval of 1 to 1.5 m along the main line. Motorized FRP boats fitted with outboard engines with manpower of 6 to 7 are employed in jigging operations. A jig like device made of a long thin steel rod attached with four hooks is used for capturing cuttlefishes and the crab is tied at the middle of the rod as bait. Spindle-shaped lead weight covered using glittery ribbon with attached hooks were also used (Fig.3). Once the cuttlefish get entangled

Fig. 3. Fishing hook used for jigging cuttlefish

Fig.4. Coconut spadix FAD unit used for cuttlefish fishing operations

in hook, the lines are lifted to collect the catch. Hand jigging is employed both day and night.

Occasionally a few catamarans are also employed for squid fishing which is again carried out during day and night. The peak season for the operation of handlines is during October -November period. Fish Aggregating Devices (FADs) made by tying 8-10 coconut spadixes

tied together using nylon rope (Fig.4) and each such unit attached to sand-filled synthetic bag or stones for anchorage are extensively used for catching cuttlefish (*Sepia pharaonis*). Several units of FADS are placed within 15 to 30 m depths by the local fishermen which are located using GPS at regular intervals. The fishing is conducted in areas ranging from 5 to 15 km from the shore mainly concentrated along Poovar to Varkala coastline. Fishing for cuttlefish using FADs is carried out only during daytime.

Long line fishing: Traditional long line (*Choora Mattu*/ *Ayiram choonda*) mainly used for catching tunas. November to March is peak longline fishing season along this coast which is operated for tunas, cobia, groupers and snappers. Mainline of number 80 monofilament nylon twine 5 nautical miles in length with 3 m branch line of twine numbers 60 to 70 attached with hooks are employed (Fig.5).

The distance between each hook is 10 m and at the end of every 50$^{th}$ hook, a float (5-litre empty oil) is tied using 1.5 mm thick rope of 75 m length and a sinker (300 g) tied with 15 cm rope. 20 floats are used for every 1000 hooks. The hook number 9 is used for tuna, number 8 for cobia and numbers 6 and 7 for groupers. The area of operation is from 15 to 25 nautical mile (nmi) from shore having depths of 48 to 72 fathoms. These crafts usually venture into the sea by 2 am to reach the fishing ground by 5 am and shooting of the lines takes one hour. The hauling of the gear starts after 6.00 am. Sardines stored in ice boxes are used as baits.

Fig.5. Long line with hooks to catch tunas

Reef long line (*Paruamatu*) :This long line is used mainly for catching *Pristipomoides* spp., rock cod, carangids, skates, cobia etc. The main line is made up of number 120 monofilament twine of 4 nmi length with 1.5 m branch lines made up of. number 80 monofilaments attached with hook number 9. The distance/length between each hook is 5 m and for every 100 hooks, a floating line is tied using 1.5 mm thickness rope of 125 m length and two 5 litre empty oil cans are tied to the float line for floatation besides a sinker (300 g) tied with 15 cm rope. The total number of floats used is about 20 for a long line with 300 hooks (Fig.6). The depth of operation is 55, 65, 75 and 110 fathoms at distance of 30-110 nmi from shore.

Shark long line (*Shravu mattu*): In this long line billfishes, sailfish, sharks, yellowfin tuna and rays are caught using either varieties of live coastal tunas or mackerel as bait. The main line is made up of Number140 monofilament nylon twine with 25 to 90 m branch lines made up of number 110 monofilaments attached with 1 feet long thin silver wire-rope made of 20 strands connected using a swivel, to which hook Number 2 or 3 is attached at their distal end. The distance/length between each hook is measured 50 m with a total of 100 hooks (Fig.7). A float line of 7.5m length of 1.5 mm thick rope was also

Fig.6. Reef long line

Fig. 7. Long line commonly used for sharks and large pelagic fishes

Fig.8. Artificial baits with double hook to catch seer fish

attached at every third hook with a 5 litre empty oil can for floatation. Flag floats tied at both the ends with a black or red flag attached to a pole to identify the ends of the gear. The imported double hooks with artificial bait are now used to catch seer fish (Fig.8). Number8 hook employed for the capture of fishes weighing about 100 kg cost about ₹200 each. *Thangal vallam* as well as single day fishing boats use hooks for capturing seer fishes and other large pelagics. A bamboo stick with Number1 hook is used to remove these big fishes from the net.

## Monofilament gill net (*Roll vala, Kangoose vala*)

The size of the gear is 100 to 120 m in length with 15 m breadth having 62 mm mesh size. Head rope is of 3 mm thickness with small floats attached at every 3.5 m length and for every float a stone sinker of 150 g is attached. In addition to the small floats at every tenth float 5litre empty oil can or large spherical shaped float is also attached. (Fig.9). A total of 30 spherical floats are used in each gill net. During May to September when the sea become turbid fishermen adjust the float line to

Fig.9. Monofilament gill net

3 m and during October to April and during full moon phase, 15 m float lines are used and again during the new moon phase the float lines are reduced to 7 to 8 m length. This gear is mainly employed for catching tunas and mackerel. The float line is attached with 150 numbers of 3 inch floats arranged at intervals of 2 m and small stone sinkers corresponding to each float tied to the foot rope of the gear. The end of the net has a float line of 45 m on which 2 five litre empty cans functions as floats and the foot rope bears a four kg stone sinker. The gear is preferred due to its light weight and low visibility during day time.

## Drift gill net (*Valiya vala, Ozhukku vala*)

These gears operated throughout the year have 9 m breadth with 100 mm mesh size. On the 4 mm thickness float line 120 mm sized floats are attached at an interval of 2.5 m. After every 15 small floats one five litre empty oil can is used as floats and one kg stone sinkers tied at both ends of the gear. Thirty two foot boats for single day fishing operation within 5 to 25 nautical miles and 40 footer fishing boat with fish hold for multiday fishing of 5 to7 days are seen. These boats usually operate beyond 50 to 60 nmi with a man power of four fishermen. For multi-day fishing 15 to 30 blocks of ice are usually required for preserving the catches. During November to March fishing is conducted up to 50 to 60 nmi and during June to September fishing confined to 5 to 25 nmi. The area of fishing operation is from Kanyakumari to Varkala with operations that starts at 2 pm and the boats reaches the fishing ground by 5 to 6 pm. After shooting the gear it is hauled in after 5 hours and large tunas, seer fish, sharks etc. are caught.

## Bottom set gill net (*Thathuvala*)

This gear has 3 m breadth and is made up of 62 mm mesh size monofilaments. Float line is made of 3 mm thickness rope and every three meter a small float is attached. Two foot ropes of 1.5 mm thickness are used for attaching small lead sinkers (20 g) at 40 cm interval and the second rope is used for attaching the net. This gear is operated up to 3 nautical miles from the shore and usually operates within 1 to 1.5 nautical miles from the shore. Three to eight fishermen will be involved in fishing from a boat. In this gear, the disentangling of the fishes caught is highly time consuming and also labour intensive. Catches include flatfishes, crabs, prawns, croakers, skates, rays and chanks. This gear is operated from 5 to 9 am.

## Trammel Net (*Disco Vala*/*Konchu vala*)

This gear is made up of three layered netting with approximately 300 m length. The mesh size of the inner net is 48 to 50 mm and the outer two layers netting is of 100 to 120 mm. Head and foot ropes are of 2 mm thickness. The breadth of the gear is 2 fathoms. The float line measures 30 fathoms. At both end of the gear, three numbers of 5 litre empty oil cans were tied as floats. Besides, sinkers weighing 3 kg was also attached at the end of foot rope. At every 40 cm of the foot rope a lead sinker of 50 g size, and also every three meter of a head rope a small float was also attached. The gear is characterized with two head ropes and two foot ropes, that is head ropes for attaching the three layers of netting also and also for attaching 100 floats and the foot rope for attaching sinkers respectively. A single trammel net unit requires 3.6 kg (3 pieces of 1.2 kg) netting. Trammel nets were operated from 6 am to 7 pm. Usually 4 to 7 fishermen go for this fishing in a single boat and gear is hauled at every 30 minutes.

## Boat seine (*Thattu madi*)

This gear is made up of four net pieces, known as *ara vala, kuralu madi, thelinga madi,* and *ka vala* made of nylon and has three parts, (i) a short wide mouthed conical bag called the *madi* or net proper made of nylon, (ii) a platform known as *thattu* attached to the lower part of the gear (iii) two long wings attached to the margin of the *thattu* on either side known as *era vala*. Each wing or *era vala* measures 150 m in length with 40 meshes breadth each measuring 1.5 m from one knot to the nearest knot. The distal extremity of the wings on either side is also attached with two nylon ropes known as *Kamba*.

Two catamarans or fibreglass coated plywood boats are employed for operating this gear. The gear is loaded in one catamaran/boat and venture into the sea along with the other catamaran/boats. When a fish shoal is sighted the net is shot and one of the warps is handed over to the crew in the other catamaran/ boat. The two boats move apart and encircle the shoal in the direction opposite to the movement of the shoal. Later on, two boats come close, hauls the net simultaneously and unload the fishes from the bag portion of the net into one boat. The fishermen continue fishing operation if catches are satisfactory. The fishing season is June to October. The fishes caught in this gear are carangids, ribbonfishes, catfishes, clupeids, sciaenids, pomfrets, *Sphyraena* spp., *Sillago sihama*, balistids, *Priacanthus* spp.etc.

Along Vizhinjam coast the main gear used for squid during monsoon season (July-November) is boat seine. The motorized FRP boats fitted with outboard engines of fishermen from Anjuthengu to Kollamkodu concentrate on fishing at Vizhinjam. Boat seines operated along 3 to 10 km from the shore within 20 to 35 m depth. Boat seines are also operated from two catamarans of 5 m size comprising 6 fishermen who row the same with oars. This type of fishing carried out from Vizhinjam to Poonthura or Vizhinjam to Pulluvila, up to 18 fathoms and about 3 km from shore. Ssquids, anchovies, sardines, prawns, carangids, tuna, sciaenids, *Nemipterus* spp., *Lactarius lactarius*, pomfrets and mullets are caught in this gear.

# Rescue of stranded Hawksbill turtle in Kollam, Kerala

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On 27th March, 2019, fisher folks of Kakkathoppu, a coastal area of Kollam district in Kerala, India, found a Hawksbill turtle (*Eretmochelys imbricata*), stranded in the rocky seashore (Fig1). The turtle was live female that weighed approximately 50 kg having a carapace length of 48 cm. According to the local fishermen, the turtle was unable to swim back to sea due to ruptured carapace and fatigued condition. On primary evaluation, barnacles were observed to be covering a part of its body and the carapace as well as head region were found exposed to sunburn. No further lesions were detected on external surface of the turtle. Further, the mouth and nostrils were examined carefully for the presence of foreign bodies that may choke the upper respiratory tract of the animal and affect breathing. It was found to be clear and breathing pattern was observed to be usual for the animal. Further investigations indicated that swimming and floating mode was normal and general conditions of the animal was good. After recording the data, the turtle was released back into the sea.

Fig. 1. Stranded female Hawksbill turtle with ruptured carapace indicated

# Note on the stranding of marine mammals on Chavakkad beach, Kerala.

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The observation of marine mammals from Chavakkad beach, Kerala is reported. On 16.03.2019, a carcass of finless black porpoise, *Neophocaena phocaenoides* (Fig. 1) was observed on Akkalad beach. The porpoise measured 95 cm in total length and being in highly decomposed state morphometrics could not be recorded. The cause of death could not be ascertained and the local people buried it on the beach. On 15.02.2019, a humpback dolphin, *Sousa plumbea* (Fig. 2) was found on Akkalad beach in Chavakkad. The dolphin measured 220 cm in total length and was in a totally decomposed condition. It was buried on the beach by locals. On 26.03.2019, a Baleen whale, was found on Edakkazhiyur beach in Chavakkad (Fig. 3). The species could not be confirmed at the body was decomposed and measured about 25 feet in total length and 10 t in weight. The carcass was disposed in the sea after the stomach was cut open.

Fig. 1. Finless black porpoise, *Neophocaena phocaenoides*

Fig. 2. Humpback dolphin, *Sousa plumbea*

Fig. 3. Baleen whale *Balaenoptera* sp.

# Unusual landings of the deep-sea lobster, *Palinustus waguensis* in Sakthikulangara Fisheries Harbour

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Unusual landing of Deepsea lobster *Palinustus waguensis* was observed at Sakthikulangara Fisheries Harbour at Kollam on 15.01.2019 along with the catch of deep-sea shrimps. An estimated catch of 100 kg of *P.waguensis* was landed in multiday shrimp trawls operated at a depth of 200-250 m, during the first two weeks of January 2019. Since the inception of deepsea shrimp landings, this species was observed in stray numbers and this is the first time a landing of this magnitude was observed. The lobster was sold in local market @ 150-200 per kg for domestic consumers. Distribution of this species is reported in the Indo-west pacific region (India, Thailand, Philippines, Japan) at a depth range of 100 to 180 m. The lobsters randomly sampled ranged from 81 to 154 mm each in total length and having 15.3 to75.7 grams weigh

Fig. 1. *Palinustus waguensis* landings from Sakthikulangara Fisheries Harbour

# Emerging commercial importance for Diamondback squid in Kerala and Karnataka

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The incidental catches of Diamondback squid, *Thysanoteuthis rhombus* (Fig.1) has been reported from the Indian EEZ earlier. This monotypic oceanic species belonging to the Family Thysanoteuthidae, is found in tropical and subtropical seas of the world. A large squid species capable of attaining dorsal mantle length (DML) up to 100 cm and weighing about 24 kg, they are listed as Least Concern (http://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T163228A986608.en.) according to IUCN Red List of Threatened species. Incidentally caught in multi-day trawl, hooks and lines (jigs) and gillnets operated in Indian EEZ, they were generally discarded due to the poor market demand. Since 2017, this resource is landed in Karnataka and Kerala due to domestic market demand mainly from the restaurants. Landings of Diamondback squid was recorded in Malpe (MLP) and Mangalore (MNG) Fisheries Harbours of Karnataka and in Munambam (MFH), Cochin (CFH) and Sakthikulangara (SFH) Fisheries Harbours of Kerala. The trawl landings comprised of squids of 15.5–57.0 cm in dorsal mantle size (DML), whereas the larger squids of 57 - 67 cm DML were caught in drift-gillnets and hooks & lines (jigs). The dominant size in the trawl fishery was comprised of 25 cm DML. Major volume of landing occurred during the post-monsoon months, especially September and October with an annual estimated landing of 711 kg in 2017, from these harbours. The squid caught were auctioned and utilized for domestic consumption. The auction rate in the landing centres varied between ₹70 -80 with retail market price reaching ₹100-150 per kilogram. The diamondback squid commands good demand in international market, especially in Japan and Philippines, where the whole squid fetches 9.7 USD/kg and 25 USD/kg for the frozen mantle in retail Japanese market. Even though there is an emerging trend in retaining this species in the trawl catch, some of the trawlers continue to discard under-sized diamondback squids. Appropriate fishing gears to tap these squids in the Arabian Sea, similar to the large artificial jigs, "*arunagashi*", which are set in the 100 m zone in the Sea of Japan, can be explored.

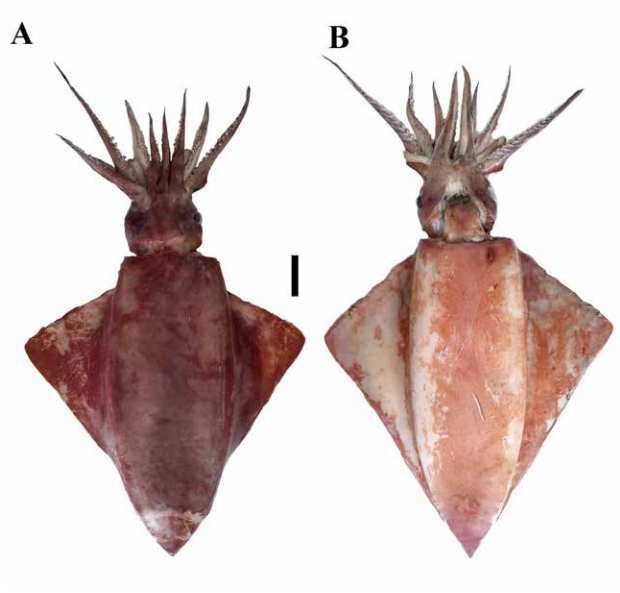


Fig. 1. Dorsal (A) and ventral (B) view of mature female *Thysanoteuthis rhombus* (67cm DML) caught from southeastern Arabian Sea (scale=10 cm)

# Unusual heavy landings of triggerfish

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The Red-toothed triggerfish *Odonus niger*, belonging to the family Balistidae, is known as "*Puzhthi*" in local parlance in Kerala. Small quantities seasonally form part of the low value bycatch (LVB) in trawlers, gill netters, ring netters etc. operated in the 40 to 80 m depth zone along the south-west coast. The maximum quantity recorded at Calicut in 2017 was 600 kg per trawler during September – October period. However, unusually heavy landings of the same was observed during the post monsoon period of 2018. The average catch recorded during September and October 2018 was 3 tons per trawler. Considerable quantities were landed during the period by the ring net operators also. Squids and trevallies also were landed in very high quantities by the trawlers during these months with other major resources being ribbon fishes, bullseyes, threadfin breams and mackerel. The volume of *O. niger* was as high as 90% of the LVB landings during some weeks of September and October 2018. They were mostly immature whose size ranged from 9 to 21 cm in total length (TL) and weighed 18 to 98 g each. Maximum numbers were observed in the 10-12 cm size group whose price varied from ₹10-15 per kg and were utilised for making fish meal.

Fig. 1. *Odonus niger* landed at Calicut.

Fig. 2: Landings of *O.niger* at Puthiyappa Fisheries Harbour, Kozhikode

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Taylor *et al*., 1998. *Aquaculture*, 162: 219-230. (Reference with more than two authors)

Friedman and Bell. 1996. *J. shellfish Res*., 15: 535-541. (Reference with two authors)

Pauly, 1980. *FAO Fish. Tech. Pap*., 234.

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